



*Environmental Technology
Verification*

Will This Thing Really Work?

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RTI

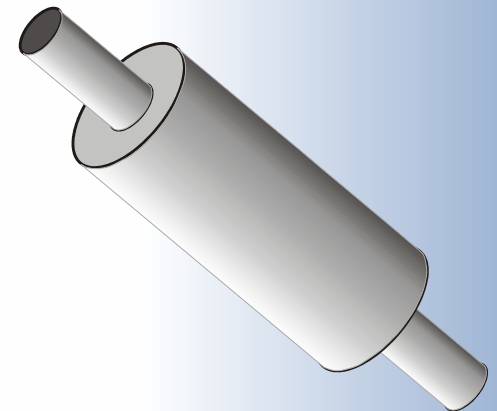
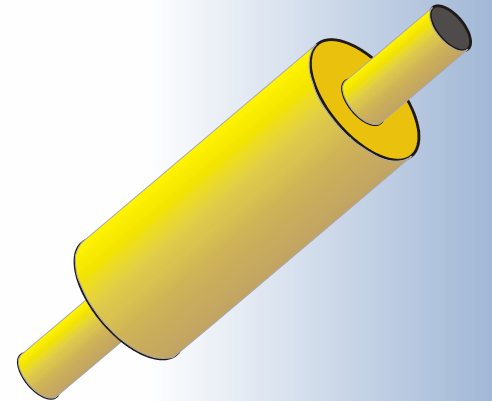
Texas Technology Showcase

Overview

- Introduction
- What is ETV?
- Status of Mobile Sources ETV

Decisions, Decisions

- Lots of new mobile source air pollution control technologies
- How do you decide? Users want a technology that:
 - ◆ Really reduces emissions
 - ◆ Doesn't affect performance
 - ◆ Is known to regulators
 - Local authority
 - U.S. EPA
 - ◆ Doesn't cost too much



ETV Provides

- Measurement of the right things
- Publicized method & results provides transparency
- Integrity from independence & QA
- Cost-Effectiveness

What is ET[✓]?

- Environmental Technology Verification
 - ◆ RTI operates the APCT VC
 - ◆ Mobile source control is only one part of the APCT VC
 - ◆ Also includes stationary source control, air & water instruments, water pollution control quality
- Objective: To verify the performance of commercial-ready air pollution control technologies using objective and quality-assured data resulting in publication of verification statements for the technologies
- Goal: To improve the environment by accelerating new environmental technologies into the market

ET✓ IS verification

- Synonyms for verification are
 - ◆ *Confirmation, Corroboration, Substantiation, Validation*

ET✓ IS NOT certification

- Synonyms for certification are
 - ◆ *To ensure, Warranty, Guarantee*

ETV Process

- Test protocol
 - ◆ designed by a broad group of expert stakeholders
- Technology applicant initiates process
 - ◆ Voluntary participation
- ETV Test
 - ◆ Test plan approved before ETV test
 - ◆ Independent, qualified labs conduct ETV test
 - ◆ Report to ETV
- Subject to internal and EPA QA review
- All results publicized

Mobile Source ETV Protocol Status

- Devices (retrofit hardware)
 - ◆ Protocol complete and posted on web
- Fuel and Lubricant Modifications
 - ◆ Protocol near completion
- Selective Catalytic Reduction (SCR)
 - ◆ Near completion
 - ◆ Similar to devices protocol with some additional safety emphasis and NH_3 measurements

MS ETV “Devices”

- Diesel oxidation catalysts (DOC)
- Diesel PM Traps
- Engine Modifications
- Fueled by “standard” No. 2 diesel or ULSD
- Combinations of two or more devices as a single system
- Other devices that do not enter the exhaust or fuel – EPA has final decision
- Protocol at <http://etv.rti.org/apct/documents.cfm>

Mobile Source ETV: Example Verification Test

- Single technology, fueled by both No. 2 diesel and ULSD compared to a No. 2 D baseline, for a single engine
- Requires 5 ETV test series:
 - ◆ Baseline engine on No. 2 diesel
 - ◆ Degreened technology on same engine with No. 2 diesel
 - ◆ Aged technology on same engine fueled by No. 2 diesel
 - ◆ Degreened technology on same engine with ULSD
 - ◆ Aged technology on same engine fueled by ULSD
- Generates 4 ETV statements from the single baseline when its emissions are compared to emissions from each of the other four test series

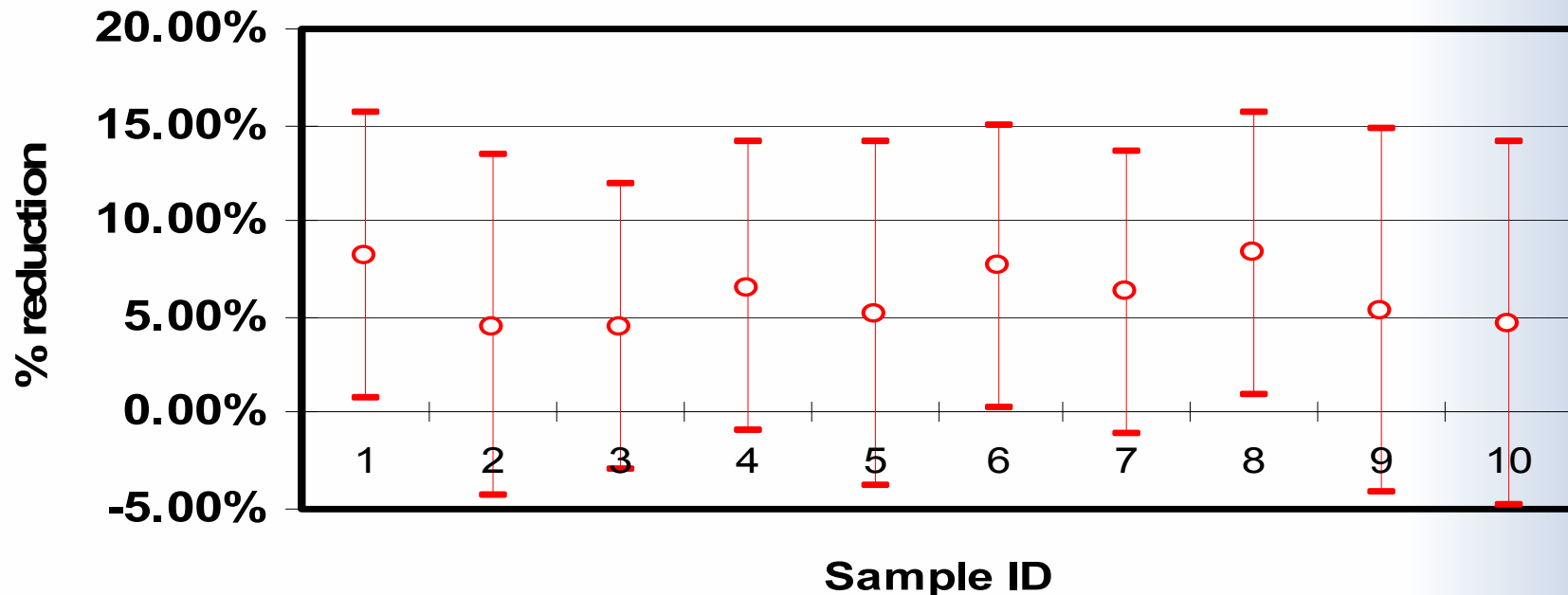
Mobile Source ETV: Devices

- Emissions reductions from engine cert. level
- EPA requires de-greened and aged technologies versus each baseline engine
 - ◆ Often the 3 test series are done closely in time
- Multiple engine testing required for broad applicability - EPA-OTAQ decision
- FTP engine dynamometer tests
 - ◆ Minimum of 1 cold-start, 3 hot-start tests
 - ◆ More tests may be required (to detect effect) or desired (to narrow confidence interval)

More tests might be required

- To demonstrate that a low emission reduction technology actually did something. ETV requires 95% confidence that the effect of the technology be distinguishable from zero.

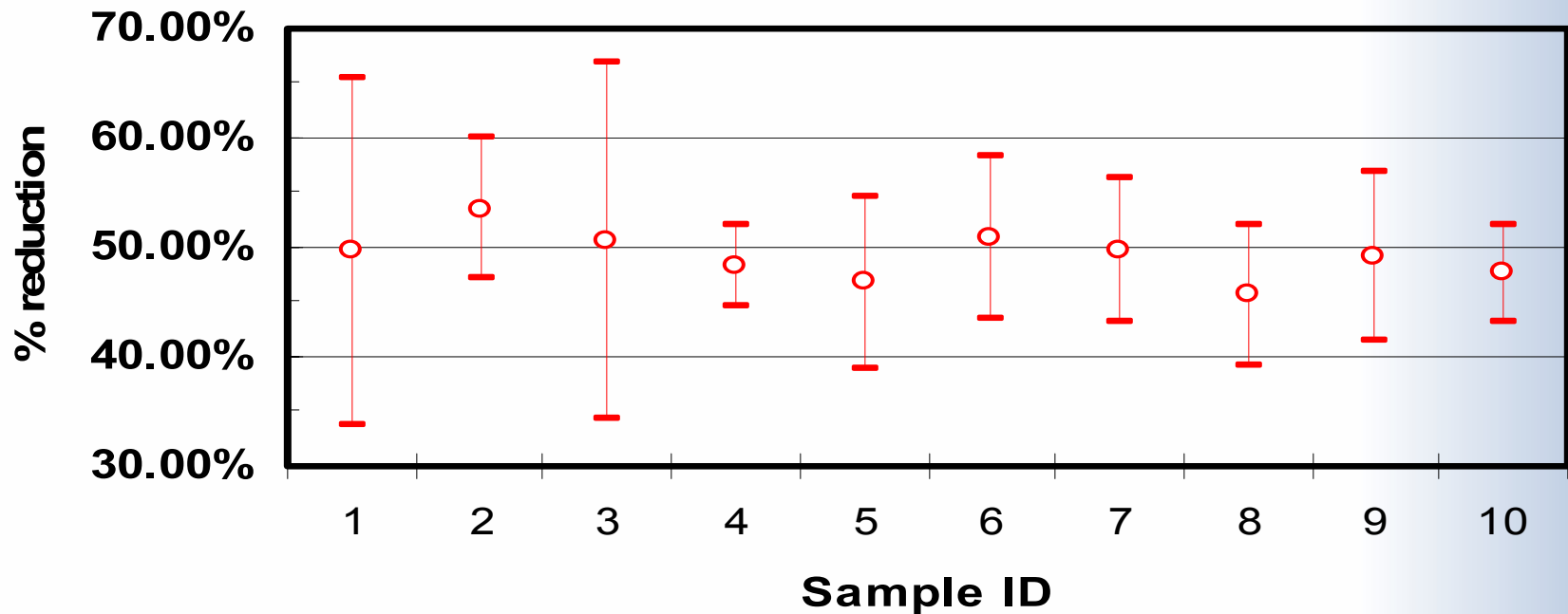
**10 sets of 3 randomly selected points for the 5%
Reduction, 2% std.dev data**



More tests might be desired

- To narrow the 95% confidence interval about the mean

**10 sets of 3 randomly selected points for the
50% Reduction, 4% std.dev data**



ETV of Devices: Results Presented

- Description of technology, test engine, and any special requirements
- Mean and Confidence Interval for emissions reduction from baseline for PM, NO_x, CO, and HC when run on indicated fuel
- Also emissions reduction for CO₂, fuel utilization, engine power, system back pressure, etc.
- Information about maintenance, other issues

ETV of Fuel Modifications

- Includes diesel engines and light-duty gasoline vehicles
- Two classes of fuel technologies
 - ◆ Immediate effect - Emissions reduction “immediately” detectable and no residual effect on engine
 - ◆ Cumulative effect - Must be used for days or weeks to have full effect and has a residual effect
- Lubricants as an emission control technology is a ‘new’ concept

Fuel Modifications ETV: Immediate Effect

- Emissions reduction comparison of
 - ◆ Engines on standard fuel as baseline
 - ◆ Engines on modified fuel
- Fuel modification must be EPA-registered
- FTP engine dynamo test (cold + 3 hot start tests minimum) + SET is basic test module
 - ◆ More tests may be required or desired
 - ◆ PM, NO_x, CO, HC, CO₂, power, fuel utilization
- Test module is applied in an alternation of:
 - ◆ base / flush / fuel mod. / fuel mod. / flush / base

Fuel Mods ETV: Cumulative Effect

- Emissions reduction comparison of
 - ◆ Engines on standard fuel as baseline
 - ◆ Engines on modified fuel
 - ◆ Multiple engines for full-fleet ETV
- Fuel modification must be EPA-registered
- Same basic test as immediate effect except not alternating base / mod.
- Emissions reduction comparison by statistical analysis of sequential base- and modified fuel engine tests

Fuel Mods ETV: Lubricants

- Emissions reduction comparison of
 - ◆ Engines on standard lubricant as baseline
 - ◆ Engines on modified lubricant
 - ◆ Multiple engines for full-fleet ETV
- ETV evaluates only emissions characteristics
- Emissions reduction comparison by statistical analysis of sequential base- and modified lubricant engine tests
- Still more tests to establish performance plots

Fuel Modifications ETV Result

- Description of technology, test engine, and any special requirements
- Mean and Confidence Interval for emissions reduction for pollutants when run on indicated fuel compared to standard fuel
- Also emissions reduction for CO₂, fuel utilization, engine power, system back pressure, etc.
- Information about maintenance, other issues

Mobile Source ETV: Costs

- **Initially** - EPA funded ETV kick-off work, protocol development, publicity, and much of the initial verifications
- **Now** -- EPA is funding only:
 - ◆ New protocol development
 - ◆ APCT VC management and QA review
- **Now** – Applicant pays ETV Testing costs
 - ◆ Normal test lab cost (+ extra ETV QA requirements)
 - ◆ APCT VC office costs for test planning, QA, reporting

Bottom Line for Technology Users

- ETV is another tool in your toolbox
 - ◆ Good data
 - ◆ Known process
- You will still have to
 - ◆ Be alert for helpful technologies
 - ◆ Do your homework before buying

Bottom Line for Technology Applicants

- Do your development before coming to ETV
- Good ETV results can be an effective sales tool
- ETV will be worth the money

Information on ETV?

■ Mobile Sources ETV at the APCT VC

- ◆ <http://etv.rti.org/apct/mobilefaq.cfm>
- ◆ Email list for upcoming meetings & developments
 - Request to Jenni Elion at jme@rti.org

■ Overall APCT ETV Program

- ◆ <http://etv.rti.org/apct/generalfaq.cfm>

■ EPA ETV

- ◆ <http://www.epa.gov/etv/>

Product Verification

- ETV

- ◆ etv.rti.org/apct/documents.cfm

- EPA Voluntary Reduction Program

- ◆ www.epa.gov/otaq/retrofit/

- California Air Resources Board

- ◆ www.arb.ca.gov/diesel/mobile.htm

The End